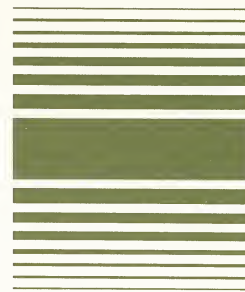


CBS LABORATORIES
TECHNICAL
BULLETIN



CBS LABORATORIES
STAMFORD, CONNECTICUT
A DIVISION OF COLUMBIA
BROADCASTING SYSTEM, INC.

VOLUMAXTM
AUTOMATIC
PEAK
CONTROLLER

DOUBLES EFFECTIVE
RADIATED
PROGRAM POWER

COMPLETELY
SOLID-STATE





CBS LABORATORIES VOLUMAX AUTOMATIC PEAK CONTROLLER

Like its companion-piece, the CBS Laboratories' Audimax,[®] the new solid-state Volumax is a tool to help the broadcaster achieve maximum program power from each watt of carrier power.

ELIMINATES LIMITER SHORTCOMINGS

The Volumax is functionally similar to conventional peak limiters only in that it prevents overmodulation of a carrier by instantaneous program peaks. However, Volumax overcomes the handicaps inherent in peak limiters.

With conventional peak limiters, the broadcaster has to choose between two evils. Either program level must be reduced so that limiting of peaks will not be drastic enough to cause distortion and "pumping," or this audible distortion must be tolerated.

Pumping in conventional limiters is usually moderated by the use of long recovery times. Thus, during the intervals immediately following high program peaks, valuable modulation capability is wasted as the limiter recovers from reduced gain.

MICROSECOND REGULATION; NO PUMPING

The CBS Laboratories' Volumax analyzes all program material and **automatically** chooses the most appropriate

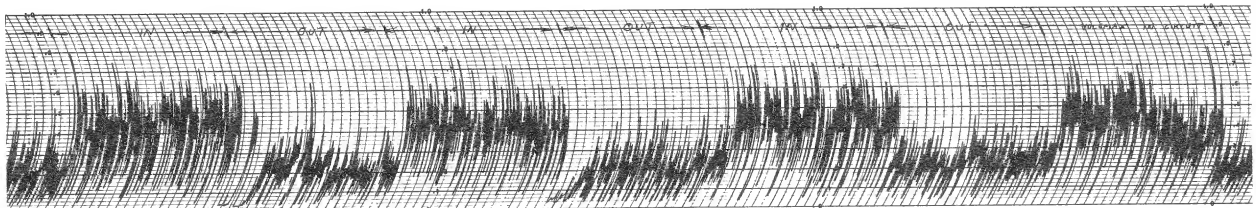
regulation speed. Limiting action may be gentle or microsecond fast—depending on the nature of the program waveform. The result is a more even, pleasant sound that can be safely transmitted at twice the program power level usually expected when conventional limiters are used.

AUDIMAX PLUS VOLUMAX; 8 TO 1 INCREASE IN PROGRAM POWER

Normally the Volumax is used in conjunction with an automatic level control such as CBS Laboratories' Audimax. The Audimax controls **average** program levels much as a human engineer "rides gain," preserving dynamic fidelity while maintaining appropriate volume levels for both program and background material. Audimax alone has typically provided a 4 to 1 increase of average program power.

In these two devices—Audimax, the studio "gain-rider" and Volumax for limiting transmitter modulation—the broadcaster has available a new standard of efficiency and excellence in audio control. Used together, they have demonstrated capability for increasing program power by the astonishing factor of nearly 8 to 1 over conventional methods.

VISIBLE PROOF



Under carefully controlled test conditions, the performance of a Volumax was compared with a popular conventional peak limiter by a non-CBS affiliated broadcasting network. Both devices were adjusted for comparable limiting and peak output resulting in 100% modulation. At five-minute intervals the two units were alternately switched into the transmission circuit and the off-the-air demodulated signals were compared in a monitoring receiver. The above chart of a recording VU meter shows the results. Volumax provided nearly twice the modulation level of the conventional limiter.

A BONUS FOR AM BROADCASTERS

In AM broadcasting, negative peaks must be kept below 100% modulation to prevent "cutting off" the carrier. Positive peaks, however, may modulate the carrier in excess of 100%.

Since the CBS Laboratories' Volumax can be operated asymmetrically at the option of the user, limiting levels for negative peaks may be kept below the 100% modulation level while positive peaks may be allowed to modulate more than 100%.

CONSISTENT PERFORMANCE REGARDLESS OF DIFFERENCES IN PEAK FACTOR

The accompanying oscillographic recording helps further explain how proper control of program peaks can permit increased program levels.

Figure A shows a syllable of speech from a male voice.

Figure B shows a syllable of speech from a different male voice.

In each case the **average** audio power as indicated on a VU meter is the same.

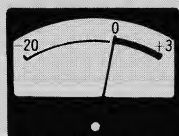
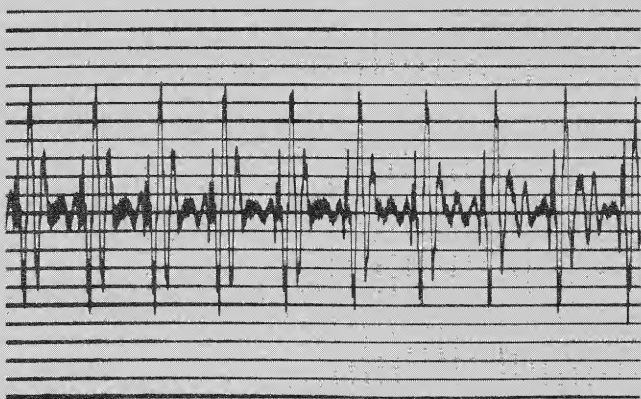
Note, however, that the waveform in Figure B contains peaks much higher than those in Figure A.

If both of these syllables were passed through a conventional peak limiter, that in Figure A would be passed without limiting. However, that in Figure B would be limited and passed at a volume level 4 db lower than the waveform in Figure A. Furthermore, during the second or two following this syllable, the limiter for Figure B would be in a condition of unnecessary gain reduction.

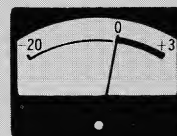
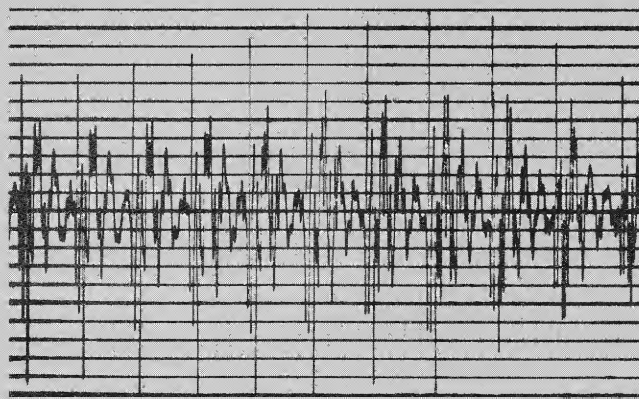
Thus, although program waves may have the same average level (as indicated on a volume indicator), differences in peak factors result in their being transmitted at different power levels to remain within the modulation limits of the transmitter.

Only CBS Laboratories' Volumax is capable of transmitting these two waveforms at the same maximum volume levels, without overmodulation or objectionable distortions.

A



B

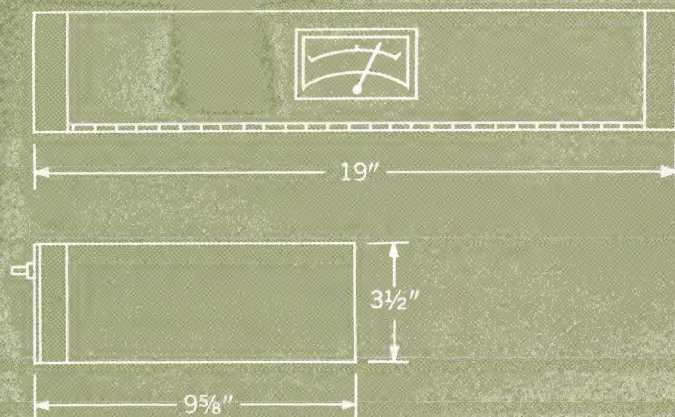


Specifications

VOLUMAX AUTOMATIC PEAK CONTROLLER



VOLUMAX Model 400



Input and Output Impedance	600 ohms, balanced or unbalanced
Input Level	-24 to +8 dbm
Maximum Output Level	Controlled peaks +21 dbm; noncontrolled peaks +25 dbm
Maximum Gain	70 db re +21 dbm
Noise Level	Below -50 dbm
Frequency Response	Flat within 1 db, 50 to 15,000 cps
Harmonic Distortion	Less than 1% from 50 to 15,000 cps throughout normal control range
Attack Time	Less than 1 microsecond or 2 milliseconds, depending on program waveform
Recovery Time	140 milliseconds
Maximum Operating Temperature	55°C
Power Requirements	15 watts at 115/230 volts AC, 50/60 cps
Physical Dimensions	Fits standard 19" rack, 3 1/2" high; 9 5/8" deep
Shipping Weight	17 lbs.

*For further information, please call or write
the Professional Products Department—*

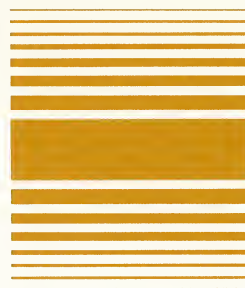
CBS LABORATORIES

Stamford, Connecticut
A Division of Columbia Broadcasting System, Inc.



CBS LABORATORIES

TECHNICAL BULLETIN

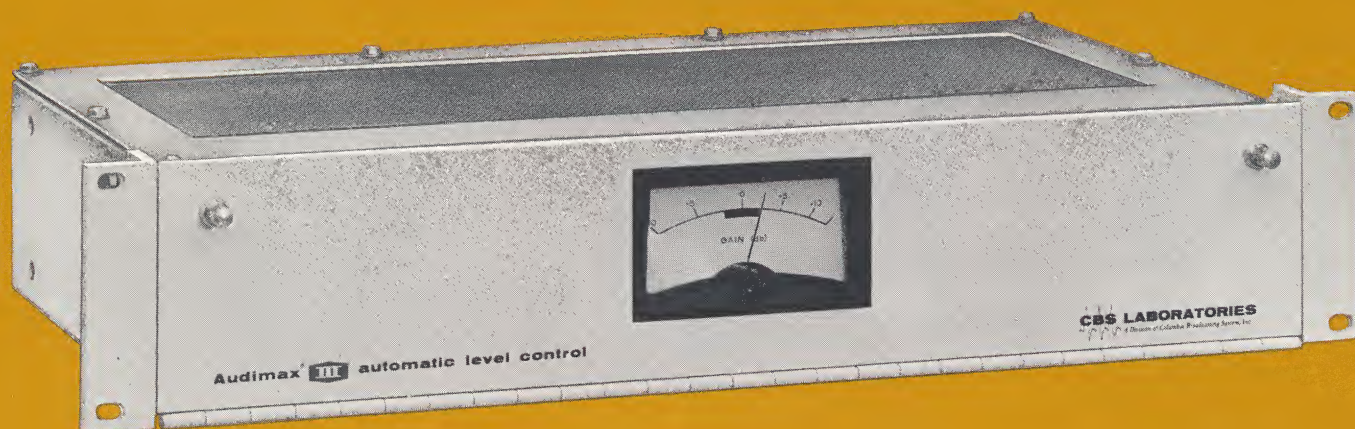


CBS LABORATORIES
STAMFORD, CONNECTICUT
A DIVISION OF COLUMBIA
BROADCASTING SYSTEM, INC.

AUDIMAX[®] III SOLID-STATE AUTOMATIC LEVEL CONTROL

FEATURING:

SOLID-STATE CIRCUITRY
GATED GAIN STABILIZATION
RETURN-TO-ZERO FUNCTION
MONOPHONIC OR MPX OPERATION



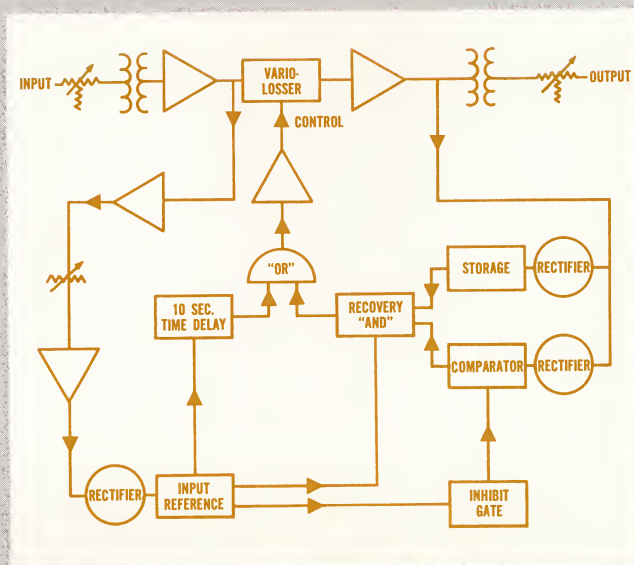


AUDIMAX III SOLID-STATE AUTOMATIC LEVEL CONTROL

Unconditionally guaranteed to outperform ordinary compressors, limiters or AGC's, the new solid-state Audimax III offers the ultimate in automated gain control combined with the extreme reliability of solid-state circuitry. Only CBS Laboratories can offer the combination of experience gained through working with computer logic circuits, NASA quality and assembly techniques, and the vast CBS broadcasting complex for field testing.

The exclusive **Gain Platform** principle permits gain to remain on a stable plateau over a wide range of input levels rather than continuously allowing it to rise and fall with consequent distortion, thumping and pumping, and audio "holes." Its unique **Gated Gain Stabilizer** acts to bridge through program lapses and thus eliminate "swish-up" of background noise. A special **Return-to-Zero** function returns gain to normal during standby conditions.

These Audimax principles apply not only to radio and television stations, but also are necessary in recording, public address, background music, and two-way communication systems as well.



AUTOMATIC GAIN RIDING— the Gain Platform

Audimax solid-state logic circuitry monitors the incoming signal and compares it with its memory of average program content over a preceding period of time. This is a four-dimensional activity (input level, output level, memory, time). Figure 1 is a two-dimensional representation. For instance, when input levels fall within the limits A and B, Audimax maintains constant gain, as shown on the Gain Platform C-D. If input becomes higher than B, Audimax quickly and inaudibly lowers the gain without thumping. When level is lower than A, Audimax raises the gain without pumping. With explosive sounds such as pistol shots and sudden audience reaction, Audimax adapts the gain without leaving "holes." It is this ability to maintain stable gain at changing reference levels that makes Audimax unique.

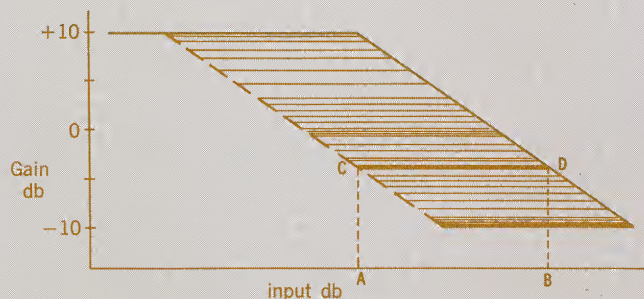
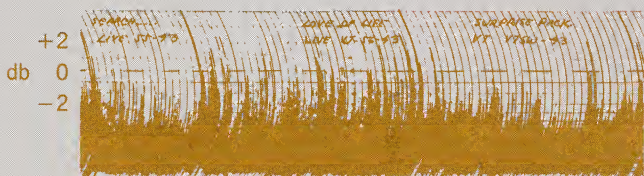


Figure 1: The gain platform principle

Figure 2:
Operating experience without (left)
and with (right) the Audimax automatic
level control.



GATED GAIN STABILIZATION

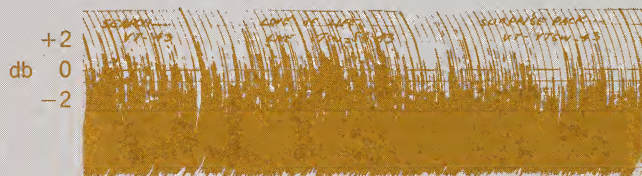
The Gated Gain Stabilizer is a special feature of Audimax. This utilizes logic circuitry to answer the question: "During a prolonged pause in the program, should the gain be turned up?" This is of the utmost importance in motion picture and television work where the naturalness of background effects must be preserved. By maintaining constant gain during these pauses, the Gated Gain Stabilizer bridges program lapses and thus eliminates the fade-out of background effects or the "swish-up" of background noise.

RETURN-TO-ZERO FUNCTION

This is still another special feature of Audimax. Whenever standby conditions occur, Audimax waits about 10 seconds while keeping the gain steady at the last correct setting. Then, when its memory unit is convinced that the program has ended, it slowly returns to normal gain thus retaining background effects at natural levels. With this unique feature, Audimax is in position to instantly provide the proper level upon resumption of the program.

INCREASED MODULATION and MARKET COVERAGE

While performing its control functions automatically, Audimax boosts overall levels. Figure 2 shows a comparison test of two similar one-hour programming segments. The left chart is a VU meter recording of the programming when skilled manual level control was used; the right chart represents programming with the Audimax. The average modulation with the Audimax increased by 6 db, a 300% increase in radiated program power—which represents a quadrupling of the potential market coverage. Over a thousand radio and television stations are now using Audimax, the standard of excellence in automated audio control.



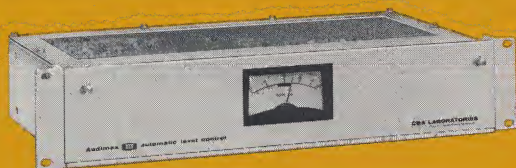
Specifications

AUDIMAX III

SOLID-STATE

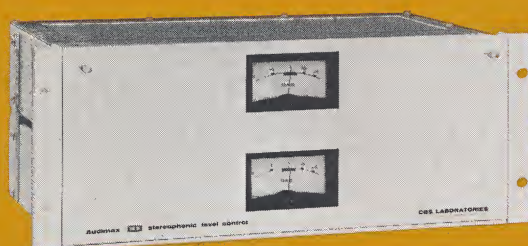
AUTOMATIC

LEVEL CONTROL



AUDIMAX III
Model 444

Frequency Response	Flat within 1 db, from 50 to 15,000 cps
Harmonic Distortion	Less than 1% from 50 to 15,000 cps at +16 dbm output
Noise Level	Below -60 dbm at normal gain
Control Characteristic	± 10 db of gain control
Gated Gain Stabilizer	Threshold adjustable from -24 db to normal input
Return-to-Zero Function	Returns gain to normal during pauses greater than 10 seconds
Maximum Gain	50 db
Input and Output Impedance	600 ohms, balanced or unbalanced (150 ohms optional)
Normal Output Level	+11vu
Maximum Output	+25 dbm
Minimum Input Level	-30vu
Physical Dimensions	Standard 19" rack mounting, 3½" high, 9⅝" deep
Power Requirements	15 watts at 115/230 volts AC, 50/60 cps
Shipping Weight	17 lbs.



AUDIMAX III S
(For Stereophonic Operation)
Model 445

Consists of two Audimax III instruments, as specified above, that are physically and electronically coupled to provide simultaneous gain control in both channels. The Gain Control in Audimax III S is a function of the stereophonic sum signal (L+R), thus preserving spatial perspective and preventing undesirable "ping-pong" effects.

Physical Dimensions	Standard 19" rack mounting, 7" high, 9⅝" deep
Shipping weight	34 lbs.

*For further information, please call or write
the Professional Products Department—*

CBS LABORATORIES

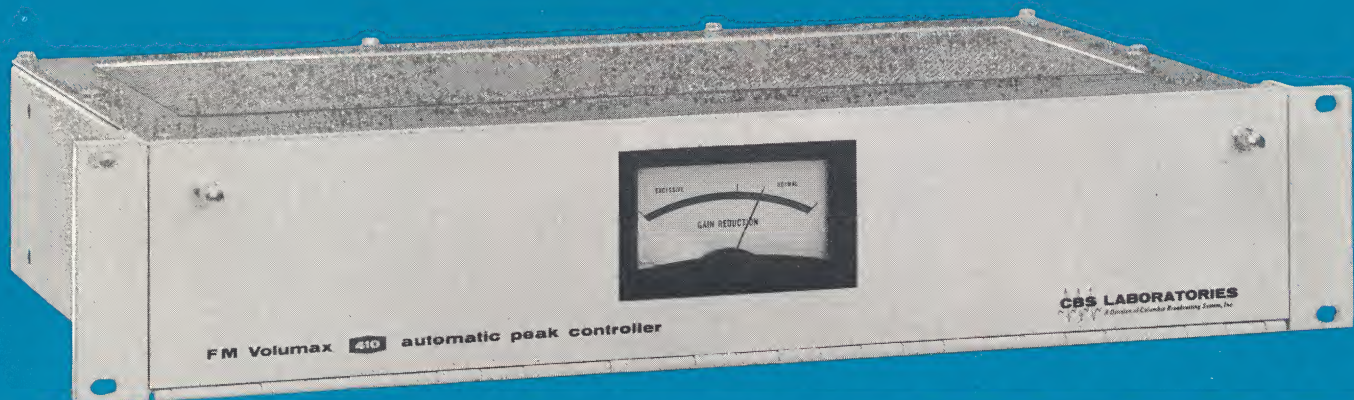
Stamford, Connecticut
A Division of Columbia Broadcasting System, Inc.

CBS LABORATORIES
TECHNICAL
BULLETIN

CBS LABORATORIES
STAMFORD, CONNECTICUT
A DIVISION OF COLUMBIA
BROADCASTING SYSTEM, INC.

INTRODUCING THE NEW FM VOLUMAX™ AUTOMATIC PEAK CONTROLLER

Prevents overmodulation caused by pre-emphasized signals
Provides higher modulation levels without distortion
Unconditionally guaranteed
Completely Solid-State



CBS LABORATORIES FM VOLUMAX AUTOMATIC PEAK CONTROLLER

After years of experience and research in audio control, CBS Laboratories has solved the FM overmodulation problem created by pre-emphasized audio signals. No longer is it necessary to endure the pumping of limiters or the distortion of clippers, or to settle for anything less than the full potential average program power available from your transmitter. CBS Laboratories' new FM Volumax offers positive prevention of overmodulation and SCA crosstalk **without distortion**.

THE PROBLEM The standard 75 microsecond pre-emphasis curve produces a 17 db amplitude increase at 15 kc. If the low frequencies are transmitted at the 100% modulation level, then higher frequencies with the same program energy distribution could modulate up to 700% at 15 kc. The shaded area of Figure 1 shows this range of potential overmodulation. However, in actual programming, the problem is not quite so severe, since 15 kc levels are seldom equal to those of the low frequencies. Nevertheless, studies have shown that musical effects such as cymbal crashes can easily cause overmodulation up to 300%. Figure 2 shows an oscillo-

graphic recording of such potential overmodulation. Note that the peak level of this cymbal crash in an orchestral selection is 9 db higher after pre-emphasis. In order to safely transmit this signal, the FM broadcaster would have to reduce his low frequency modulation level to approximately 35% and operate with less than $\frac{1}{8}$ of his authorized maximum program power.

OBsolete CONTROL METHODS Instead of operation at reduced levels, various methods of automatic control have been tried from time to time. **Limiting before pre-emphasis** controls low frequencies but does not permit a substantial increase in program levels. **Limiting after pre-emphasis** controls overmodulation, but often at the cost of severe pumping and sudden annoying losses in level. On the other hand, **clipping after pre-emphasis**, (sometimes called "high-speed filtering") removes only the offending peaks, but creates new problems of serious distortion. Receiver de-emphasis may minimize the harmonic distortion to some extent, but will not eliminate the more annoying intermodulation distortion caused by clipping such signals as muted trumpets and sibilant vocal sounds.

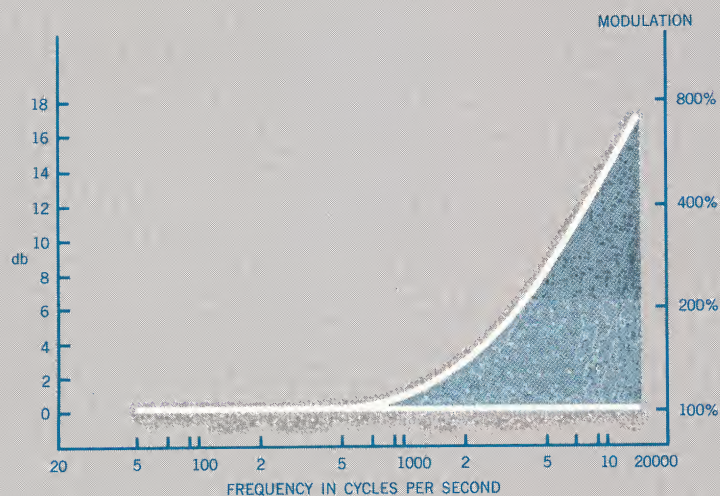


Figure 1. Area of potential FM overmodulation (75 μ sec pre-emphasis curve).

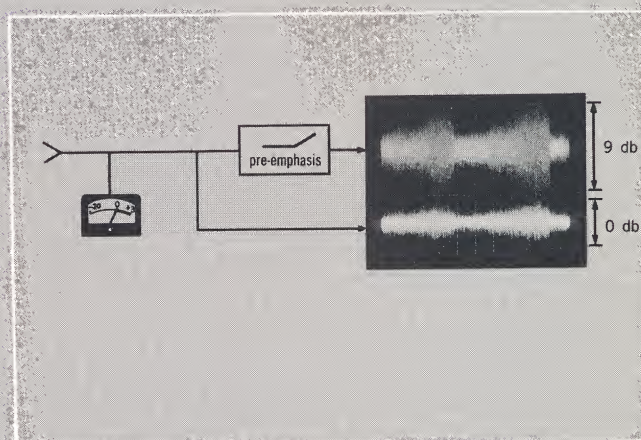


Figure 2. Diagram and oscilloscope photos showing audio peak levels of cymbal crash with and without pre-emphasis.

THE SOLUTION CBS Laboratories new FM Volumax solves the FM broadcaster's dilemma once and for all by using precise triple action control. Time-varying functions are used to control the low and high frequency amplitudes separately, and instantaneous final limiting assures that no overmodulation will occur. A new and unique method of dynamic frequency compensation is used to adjust high frequency levels and process all frequencies at reference level without distortion. As a matter of fact, the new FM Volumax can even be left in the circuit when making proof-of-performance distortion measurements.

Figure 3 illustrates the amplitude response of the new FM Volumax. At low levels, where pre-emphasis can cause no overmodulation, the frequency response is flat over the entire range. At maximum levels, the response is the inverse of the pre-emphasis slope. Thus, for any level or frequency, the maximum output is precisely equal to the 100% modulation level—after transmitter pre-emphasis. This method of control is comparable to that used in live recording sessions. Very often certain

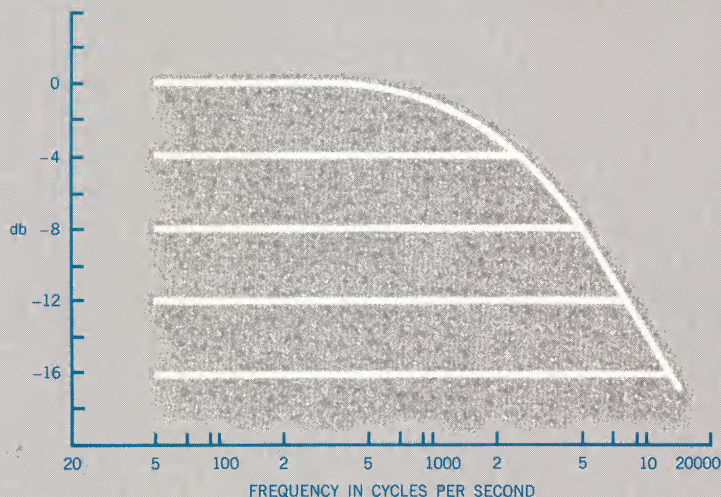


Figure 3. Amplitude response of FM Volumax.

instruments, especially percussion, will be moved away from the microphones or be required to play softer to accommodate the limitations of the recording medium. The new FM Volumax now extends this same principle to the broadcast medium.

HOW IT WORKS Referring to Figure 4, low frequencies are first limited by a time-varying amplitude control. After internal pre-emphasis, which permits the FM Volumax to anticipate the effect of transmitter pre-emphasis, high frequency amplitudes are automatically adjusted by the dynamic frequency compensator. Following this, an instantaneous peak limiter provides absolute protection against overmodulation. A final de-emphasis network is used to counter the effect of the earlier pre-emphasis and restore the original low level spectral balance.

Unconditionally guaranteed to outperform all other related devices, the new FM Volumax offers the ultimate in automated control combined with the high reliability of solid state circuitry.

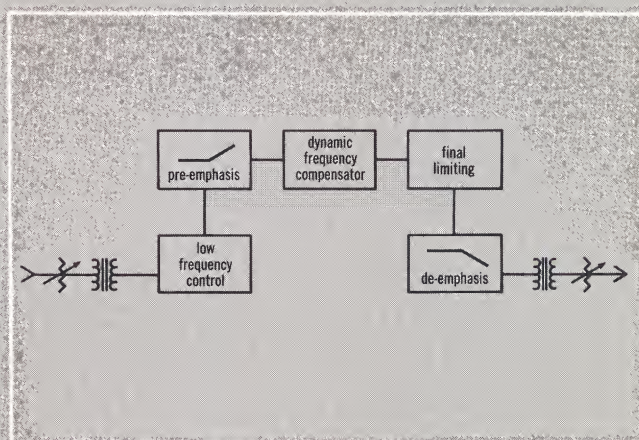
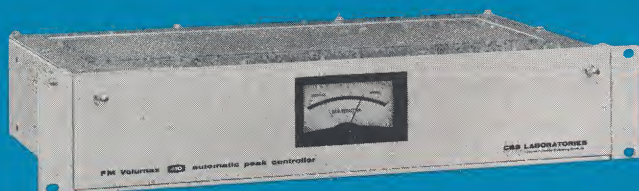


Figure 4. Block Diagram—FM Volumax.

Specifications FM VOLUMAX AUTOMATIC PEAK CONTROLLER



**FM VOLUMAX
MODEL 410**

Input and Output Impedance	600 ohms, balanced or unbalanced (150 ohms optional)
Input Level	-24 to +8 dbm
Maximum Peak Output Level	+21 dbm
Maximum Gain	50 db
Noise Level	Below -70 db re +21 dbm output
Frequency Response	Flat within 1 db, 50 to 15,000 cps, 20 db below maximum level; 75 microsecond slope at maximum level; 50 microsecond or other contours possible with simple field modification
Harmonic Distortion	Less than 1% from 50 to 15,000 cps throughout entire control range
Attack Time	Less than one microsecond or 2 milliseconds depending on program waveform
Recovery Time	140 milliseconds (low frequencies) 10 milliseconds (high frequencies)
Maximum Operating Temperature	55°C
Power Requirements	15 watts, at 115/230 Volts AC, 50/60 cps
Physical Dimensions	Standard 19" rack, 3½" high, 9⅝" deep
Shipping Weight	18 lbs.



**FM VOLUMAX for
Stereophonic Operation
MODEL 411**

FOR STEREOPHONIC OPERATION

Consists of two Model 410 FM Volumax coupled together in one frame

Physical Dimensions	Standard 19" rack, 7" high, 9⅝" deep
Shipping Weight	36 lbs.

*For further information, please call or write
the Professional Products Department—*



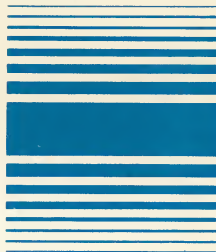
Stamford, Connecticut
A Division of Columbia Broadcasting System, Inc.



CBS LABORATORIES

STAMFORD, CONNECTICUT

A DIVISION OF COLUMBIA BROADCASTING SYSTEM, INC.



We hope that the enclosed literature will provide the information you need. If you want more specific information about any of our products, or if you want one of our representatives to contact you, please fill out the attached card and return it to us.

Thank you for your interest in CBS Laboratories.

☐ I would like to receive more information on _____

☐ I would like a representative to contact me.
Name _____
Title _____
Company _____
Address _____
City _____ State _____

FIRST CLASS
PERMIT NO. 758
STAMFORD, CONN.

B U S I N E S S R E P L Y M A I L

NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY —

C B S LABORATORIES
PROFESSIONAL PRODUCTS
HIGH RIDGE ROAD
STAMFORD, CONNECTICUT



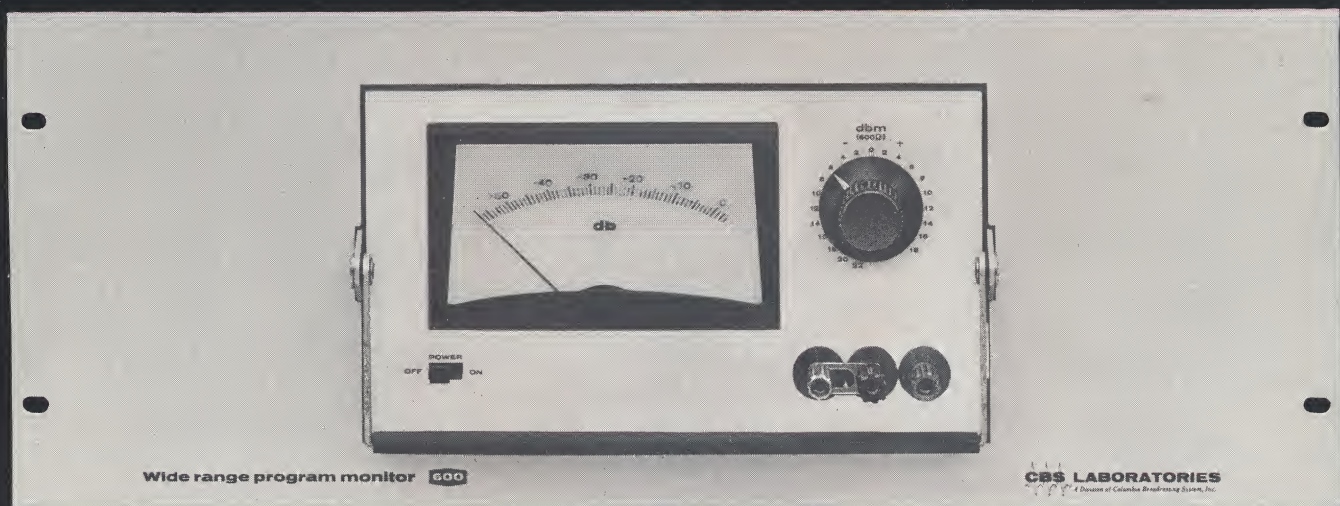


CBS LABORATORIES TECHNICAL BULLETIN



CBS LABORATORIES
STAMFORD, CONNECTICUT
A DIVISION OF COLUMBIA
BROADCASTING SYSTEM, INC.

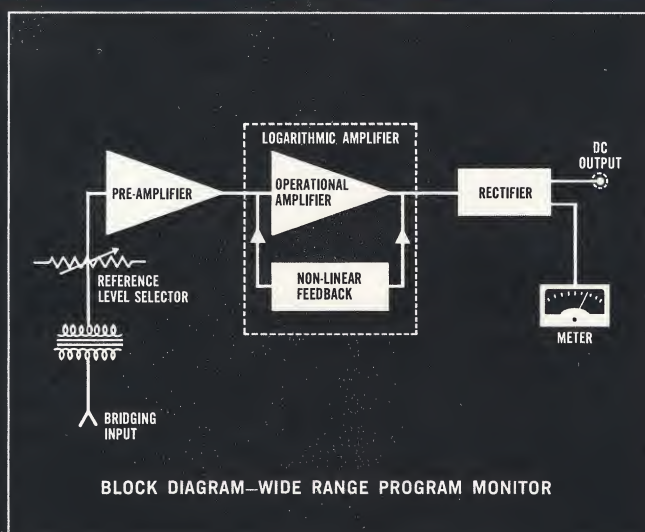
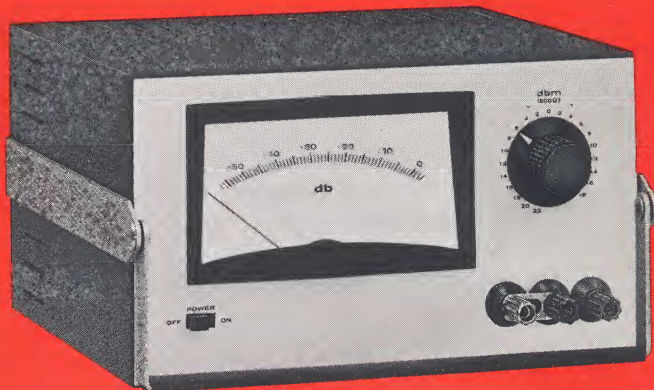
INTRODUCING THE NEW MODEL 600 WIDE RANGE PROGRAM MONITOR



The Wide Range Program Monitor combines the latest developments in audio technology with the reliability of solid-state design. It provides the user with a never-before-available professional tool for audio measurement and analysis.

- Single Linear Decibel Scale
- Measures Program, Noise, Crosstalk
- Rack Mounted—Also Portable
- Full 60 db-Wide Range
- All Solid-State
- Isolated DC Output

MODEL 600 WIDE RANGE PROGRAM MONITOR



Specifications

Reference Deflection (0 db)	Adjustable from +18 to -22 dbm
Internal Noise Level	At least 15 db below the -57 db reading
Total Measurable Range	-79 to +21 dbm
Scale	Linear 60 db-wide scale from -57 to +3 db
DC Output	Linear volts/db output is 6 volts maximum at 5500 ohms impedance. Calibrated to provide remote monitoring
Frequency Range	50 to 15,000 cps
Linearity	± 1 db
Input Impedance	15,000 ohms, bridging, balanced or unbalanced
Maximum Operating Temperature	55°C
Dimensions	In enclosure: 19" wide, 7" high, 10" deep Out of enclosure: 9" wide, 5" high, 10" deep
Power Requirements	12 watts, 115/230 volts AC
Shipping Weight	With enclosure: 14 lbs. Without enclosure: 9 lbs.

The Model 600 Wide Range Program Monitor is a unique new professional instrument that for the first time allows the measurement of program audio, noise, and crosstalk on a single 60 db-wide scale. Unlike the standard Volume Indicator which measures only the top 23 db of signal level, the new Program Monitor displays information from +3 to -57 db on a single linear decibel scale. The 0 db reference settings are adjustable from +18 to -22 dbm. This new instrument, designed specifically for professional use, allows the accurate reading of low level audio material as well as line noise measurements during program pauses. In addition, it is equipped with a separate DC output for graphic logging or remote metering.

Although the Wide Range Program Monitor is not intended as a replacement for the standard Volume Indicator, the meter ballistics are such that its readings are compatible with VU indications. This feature makes the new instrument a practical studio monitor as well as a valuable measuring tool.

For the accurate logging of program levels over the full 60 db range, the Monitor is equipped with a DC output designed to feed inexpensive linear-deflection chart recorders. This output also may be used to drive a second meter if remote monitoring is desired.

The Model 600 is available with a standard 19-inch mounting enclosure from which it can be easily removed for portable use. It is also available without the enclosure.

For further information, please call or write the Professional Products Department—

CBS LABORATORIES

Stamford, Connecticut
A Division of Columbia Broadcasting System, Inc.